AP Biology, Semester 2
Final Exam
Instructor Version

Section I: Multiple-Choice Questions

Answer Sheet

1.	E
2.	D
3.	B
4.	A
5.	D
6.	B
7.	E
8.	B
9.	B
10.	E
11.	E
12.	E
13.	B
14.	E
15.	C

16.	C
17.	C
18.	D
19.	D
20.	D
21.	C
22.	C
23.	A
24.	C
25.	B
26.	B
27.	D
28.	B
29.	E
30.	A

©Copyright2001UCCP.Allrightsreserved.

31.	**C**
32.	**B**
33.	**B**
34.	**D**
35.	**B**
36.	**A**
37.	**D**
38.	**C**
39.	**B**
30.	**B**
41.	**E**
42.	**B**
43.	**C**
44.	**B**
45.	**A**
46.	**B**
47.	**A**
48.	**E**

49.	**D**
50.	**A**
51.	**A**
52.	**C**
53.	**E**
54.	**D**
55.	**D**
56.	**C**
57.	**A**
58.	**C**
59.	**E**
60.	**E**
61.	**C**
62.	**E**
63.	**E**
64.	**B**
65.	**B**
66.	**A**

©Copyright2001UCCP.Allrightsreserved.

67.	**C**
68.	**C**
69.	**D**
70.	**A**
71.	**A**
72.	**D**
73.	**C**
74.	**B**
75.	**D**
76.	**A**
77.	**B**
78.	**D**
79.	**B**
80.	**C**
81.	**A**
82.	**A**
83.	**B**

84.	**A**
85.	**C**
86.	**B**
87.	**D**
88.	**D**
89.	**B**
90.	**C**
91.	**D**
92.	**A**
93.	**C**
94.	**D**
95.	**E**
96.	**C**
97.	**A**
98.	**B**
99.	**C**
100.	**A**

©Copyright2001UCCP.Allrightsreserved.

Section II: Free-Response Questions

1. In the 1950s, scientists determined that DNA is the genetic material of most organisms. DNA must be copied precisely during DNA replication, but it also must be able to change to allow a population of organisms to evolve. And it must hold the information necessary to encode an organism's phenotype.

A. **Describe the experiments that lead to the discovery that DNA is the genetic material.** (10 points)

ANSWER:

Griffith transformation experiment	Smooth cells and rough cells of *Streptococcus pneumonia* Smooth cells kill mice, rough cells don't kill mice Dead smooth cells don't kill mice Live rough cells mixed with dead smooth cells kill mice and acquired ability to make smooth coat
Avery and MacLeod transformation experiment	Isolated components from smooth cells and used each to individually transform rough cells Only DNA (but not RNA or protein) could transform rough cells
Hershey and Chase phage experiment	Labeled protein coat of phage with radioactive sulfur Labeled DNA of phage with radioactive phosphorus Followed each during a phage infection to see where they were Protein found in medium DNA found in cells Therefore, DNA is the genetic material

©Copyright2001UCCP.Allrightsreserved.

B. **Advances in biotechnology are allowing scientists to manipulate DNA in ways they could previously only dream of. Describe some ways scientists can manipulate DNA and explain how DNA manipulation can be used to better society.** (10 points)

ANSWER:

Agriculture	• Disease and pest resistance genes can be introduced (by Ti plasmids and DNA gun) to keep crops healthy and produce food for more people. • Increased nutritional value to help keep people who don't have much food healthy. • More fertile soil to make crops produce more food.
Medicine	• Advances in basic research lead to insights about health and medicine. • PCR used to amplify DNA for diagnostic and research purposes. • PCR and molecular biology advances makes it possible to genetically engineer bacteria and other organisms to express particular genes, which can be used as medicine or for research. • Sequencing of genomes allows location of disease genes and comparison of genes across species. • Gene therapy can potentially be used to treat and cure diseases.
Legal	• DNA fingerprint to link suspect to DNA sample found at crime scene. • DNA fingerprint to determine if a man is the father of a child.

2. Consider the following list of animals:
Earthworm
Flatworm
Frog
Jellyfish
Lamprey
Tuna

A. **Create a table of distinctive traits for these six animals as a basis for building a cladogram. Use traits that are either present or absent in a given organism. Use the jellyfish as an outgroup.** (7 points)

ANSWER:

Traits	**Earthworm**	**Flatworm**	**Frog**	**Jellyfish**	**Lamprey**	**Tuna**
Organ systems	√	√	√		√	√
Coelom	√		√		√	√
Vertebral column			√		√	√
Jaw			√			√
Lungs			√			

©Copyright2001UCCP.Allrightsreserved.

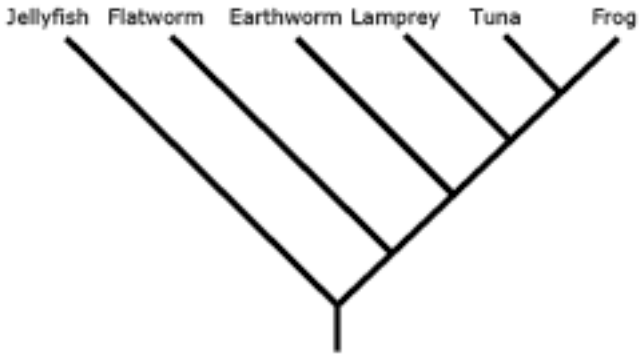
Organisms may be grouped according to shared traits, corresponding to branch points of the cladogram:

Traits	Jellyfish	Flatworm	Earthworm	Lamprey	Tuna	Frog
Organ systems		√	√	√	√	√
Coelom			√	√	√	√
Vertebral column				√	√	√
Jaw					√	√
Lungs						√

At least five traits must be used to distinguish all the animals. Traits other than those shown here are possible. Additional traits beyond the minimal five may listed without penalty; for example, the ancestral trait "true tissues," possessed by the outgroup "jellyfish" as well as all the other animals.

B. **Construct a cladogram that accurately depicts the branching of the evolutionary lines of descent of these animals.** (6 points)

ANSWER:



©Copyright2001UCCP.Allrightsreserved.

C. **Explain how the cladogram was constructed.** (7 points)

ANSWER:

1. The jellyfish (a cnidarian) is the outgroup because it branched off the main line of descent of this set of organisms before the last common ancestor of the other five. It possesses ancestral traits common to all these animals (e.g., true animal tissues).
2. Prior to constructing the cladogram, we must collect a set of derived traits that distinguish all the organisms from each other.
3. The organisms are grouped by traits they share, under the assumption that each trait evolved in a common ancestor. Groups of organisms distinguished by a trait are separated by branch points of the cladogram.
4. The outgroup (jellyfish) is the first animal to branch from the base of the cladogram. All the other animals share the trait of "organ systems".
5. The next animal to branch off is the flatworm. The remaining four animals share the trait "coelom."
6. The next animal to branch off is the earthworm. The remaining four animals share the trait "vertebral column."
7. The next animal to branch off is the lamprey. The tuna and frog share the trait "jaw."
8. The tuna and frog are distinguished by the trait "lungs."

3. Cells transport substances across their membranes. Describe the following transport processes and explain the mechanism of each one, include an explanation of the driving force behind each type of transport.

A. **Osmosis** (6 points)

ANSWER:
Cell membranes are semi-permeable barriers between cells and their environment: water molecules can move through this membrane, but not much else. The movement of solvent molecules through a membrane from a region of lower solute concentration to a region of higher solute concentration is called osmosis. For a cell, this usually means the movement of water into the cell. Energy is not required for this to take place.

B. **Carrier-mediated diffusion** (7 points)

ANSWER:
The spontaneous movement of a substance from an area of higher concentration to an area of lower concentration is called diffusion. Diffusion must, by definition, occur in the direction of a concentration gradient. If this process is assisted by membrane proteins, it's called carrier-mediated diffusion. Carrier-mediated diffusion is done by integral membrane proteins that escort small polar molecules or ions through the hydrophobic interior of a membrane. No energy is required for diffusion to take place.

©Copyright2001UCCP.Allrightsreserved.

C. **Active transport** (7 points)

ANSWER:
Active transport requires energy, can work even against a concentration gradient, and often involves the cotransport of another molecule or ion. An integral membrane protein will bring the substance into the cell against the concentration gradient.

4. The three stages of early embryonic development are cleavage, blastula formation and gastrulation. Describe the essential features of each stage.

A. **Cleavage** (6 points)

ANSWER:
This is the stage of development where the nutrient-rich egg cleaves to form a ball of cells. In many animals, nutrient-rich cells at the vegetal pole divide more slowly than the cells nearer the animal pole. These asymmetrical cell divisions lay the groundwork for differentiation later in development.

B. **Blastula formation** (7 points)

ANSWER:
As the cleaving cells continue to divide, a cavity called the blastocoel is formed in the center of the ball of cells. The embryo at this stage is called a blastula. Some of the vegetal cells at this stage start to make yolk, which will be used as the embryo develops. Blastula cells are already differentiated to some extent, as Spemann and Mangold showed in the 1920s: moving blastula cells from one part of a frog blastula to another could induce a second frog embryo from the same egg.

C. **Gastrulation** (7 points)

ANSWER:
An indentation forms at one side of the blastula as cells invaginate to form what will become the end of the digestive system in the animal. The presence of the blastocoel makes it easier for the cells to push inwards. By the time gastrulation is complete, the three primary germ layers or cell types have become differentiated. These are the ectoderm, mesoderm, and endoderm.

©Copyright2001UCCP.Allrightsreserved.